U.S. Energy Storage Monitor:

Q3 2018 Executive Summary

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Contents (Full Report)

About This Report

U.S. Energy Storage Monitor is a quarterly publication of GTM Research and the Energy Storage Association (ESA). Each quarter, we gather data on U.S. energy storage deployments, prices, policies, regulations and business models. We compile this information into this report, which is intended to provide the most comprehensive, timely analysis of energy storage in the U.S.

Notes:

- All forecasts are from GTM Research; ESA does not predict future pricing, costs or deployments
- References, data, charts and analysis from this report should be attributed to "GTM Research/ESA U.S. Energy Storage Monitor"
- Media inquiries should be directed to Mike Munsell from GTM Research (munsell@gtmresearch.com) or Tori Montano with the Energy Storage Association (202.765.2803)

For more information or to purchase the full report, visit www.energystoragemonitor.com.

Authors:

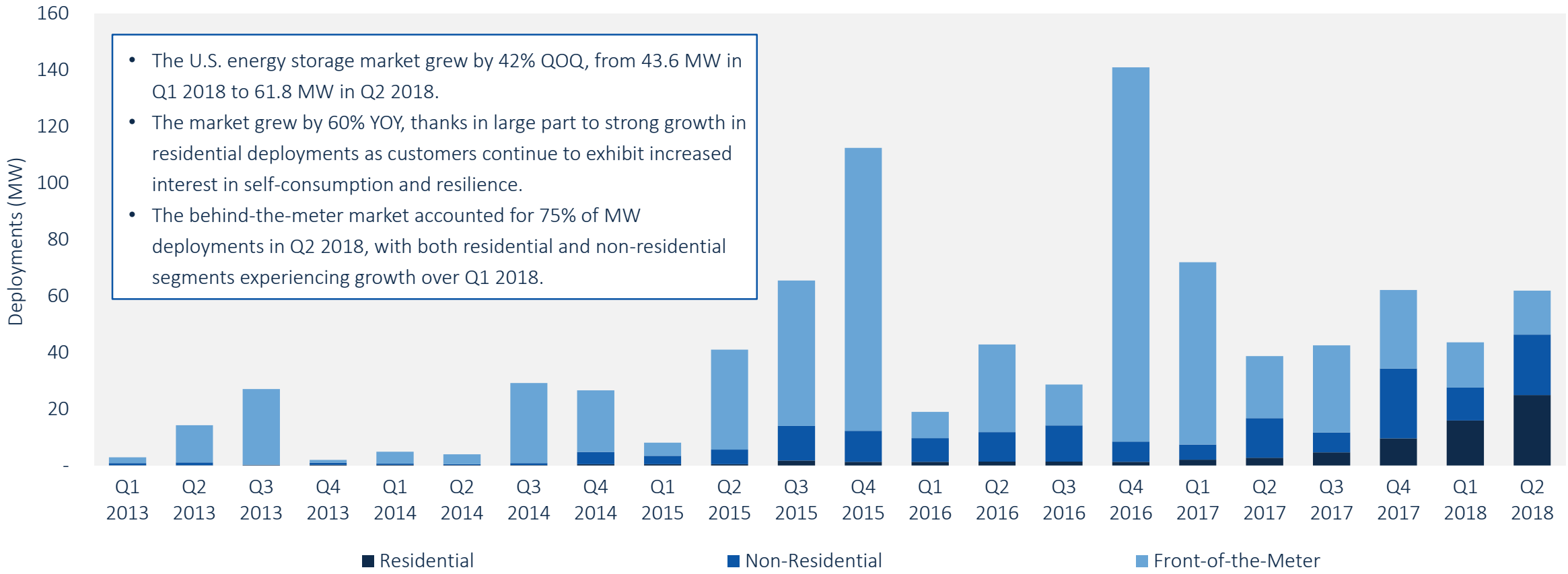
- Brett Simon, Senior Analyst, Energy Storage
- Daniel Finn-Foley, Senior Analyst, Energy Storage
- Mitalee Gupta, Analyst, Energy Storage

Content Support:

- Ravi Manghani, Director, Energy Storage
- Elta Kolo, Ph.D., Research Manager, Grid Edge
- Austin Perea, Senior Analyst, Solar
- Colin Smith, Senior Analyst, Solar
- Gregson Curtin, Summer Associate, Storage

U.S. Q2 2018 Deployments in Megawatts Grew by 60% YOY

U.S. Quarterly Energy Storage Deployments by Segment (MW)



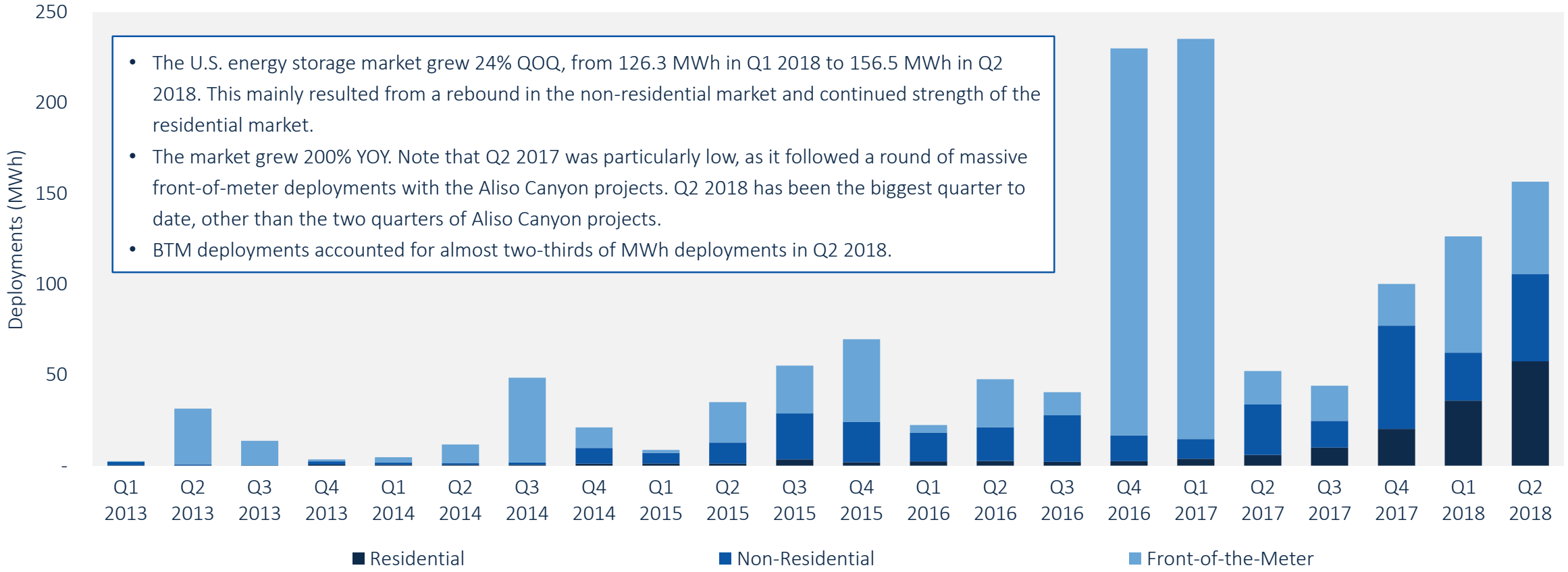
- The U.S. energy storage market grew by 42% QOQ, from 43.6 MW in Q1 2018 to 61.8 MW in Q2 2018.
- The market grew by 60% YOY, thanks in large part to strong growth in residential deployments as customers continue to exhibit increased interest in self-consumption and resilience.
- The behind-the-meter market accounted for 75% of MW deployments in Q2 2018, with both residential and non-residential segments experiencing growth over Q1 2018.

Source: GTM Research

U.S. Q2 2018 Deployments in Megawatt-Hours Grew by 3x Year-Over-Year

U.S. Quarterly Energy Storage Deployments by Segment (MWh)

- The U.S. energy storage market grew 24% QOQ, from 126.3 MWh in Q1 2018 to 156.5 MWh in Q2 2018. This mainly resulted from a rebound in the non-residential market and continued strength of the residential market.
- The market grew 200% YOY. Note that Q2 2017 was particularly low, as it followed a round of massive front-of-meter deployments with the Aliso Canyon projects. Q2 2018 has been the biggest quarter to date, other than the two quarters of Aliso Canyon projects.
- BTM deployments accounted for almost two-thirds of MWh deployments in Q2 2018.



Source: GTM Research

Top Energy Storage Markets, Q2 2018: California Leads Behind-the-Meter, Arizona Drives Front-of-Meter

Top 3 Markets by Segment in Q2 2018 (Power Capacity)

Rank	Residential
1	California
2	Hawaii
3	All Others*

Rank	Non-Residential
1	California
2	New Jersey
3	All Others*

Rank	Front-of-the-Meter
1	Arizona
2	Massachusetts
3	Texas

*GTM Research is currently monitoring 10 individual markets: Arizona, California, Colorado, Hawaii, Massachusetts, Nevada, New Jersey, New York, PJM and Texas.

Source: GTM Research

Front-of-the-Meter Policy and Market Developments, Q3 2018

Colorado

Xcel Energy announced plans to procure 275 MW of solar-paired storage by 2022.

California

SCE issued a local capacity requirements RFP for the Goleta and Santa Clara regions of the Moorpark sub-area, which could be fulfilled by storage. **CPUC** approved **SCE's PRP 2 contracts;** it also issued a decision allowing cost recovery of both a previously authorized distribution capital project and a distributed energy resources project that defers or replaces the distribution capital project. **PG&E** announced results for its Moss Landing energy storage RFP, with three projects totaling more than 500 MW planned.

Nevada

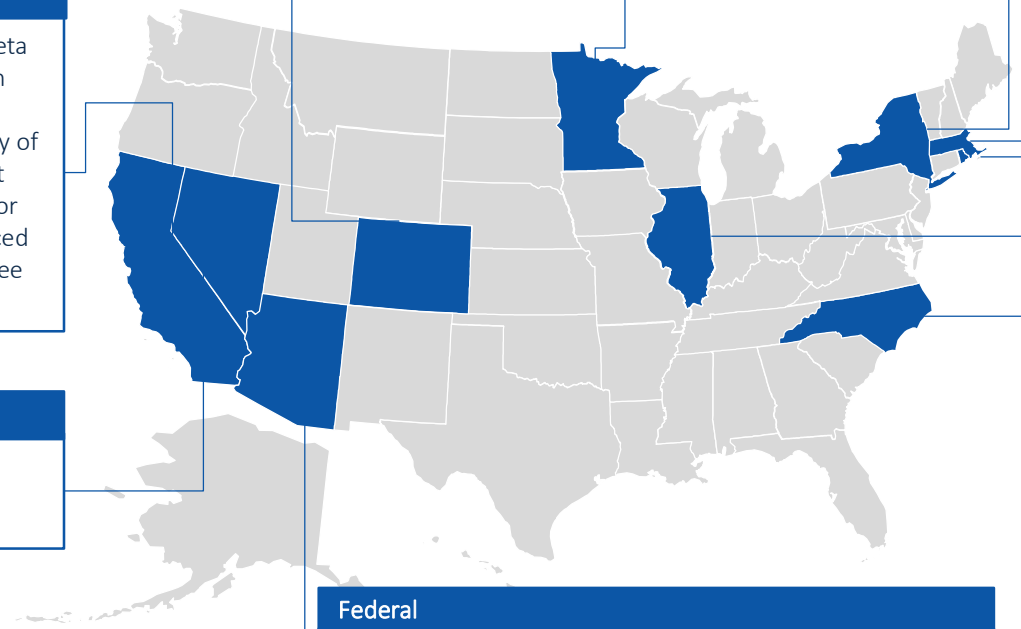
Nevada Energy announced plans for $2 billion in solar-plus-storage.

Arizona

Arizona Public Service announced a 106 MW procurement for energy storage to be added to existing solar facilities.

Minnesota

The **Minnesota state legislature's** latest budget includes numerous energy storage initiatives, including adding storage to utility integrated resource plans. After the governor's veto, however, the future of the storage provisions remains uncertain.



Federal

The **U.S. Congress** House Energy and Commerce Committee held a hearing on energy storage. The Energy and Water appropriations bill includes energy storage as a technology priority and highlights it as a resiliency tool.

New York

NYSERDA published the New York Energy Storage Roadmap outlining ratepayer benefits from storage deployments and recommended an infusion of funds to support storage deployments. **New York's Green Bank** put out an RFI on energy storage financing.

Massachusetts

National Grid added batteries to eligible tech under its ConnectedSolutions program. Proposal issued regarding capacity rights ownership under **DPU 17-146.** S. 2545 from the **state legislature** was signed into law, which would, among other storage-friendly policies, expand the state's mandate to 1 GWh.

Rhode Island

National Grid's proposed settlement includes funding for grid modernization, including a small front-of-the-meter energy storage system.

Illinois

The **Illinois Commerce Commission** held a policy session covering the future of storage, potentially signaling future investment in the market.

North Carolina

Duke Energy North Carolina's settlement with North Carolina Sustainable Energy Association includes plans for 200 MW of energy storage. The settlement was rejected but it shows renewed interest in storage outside traditional markets.

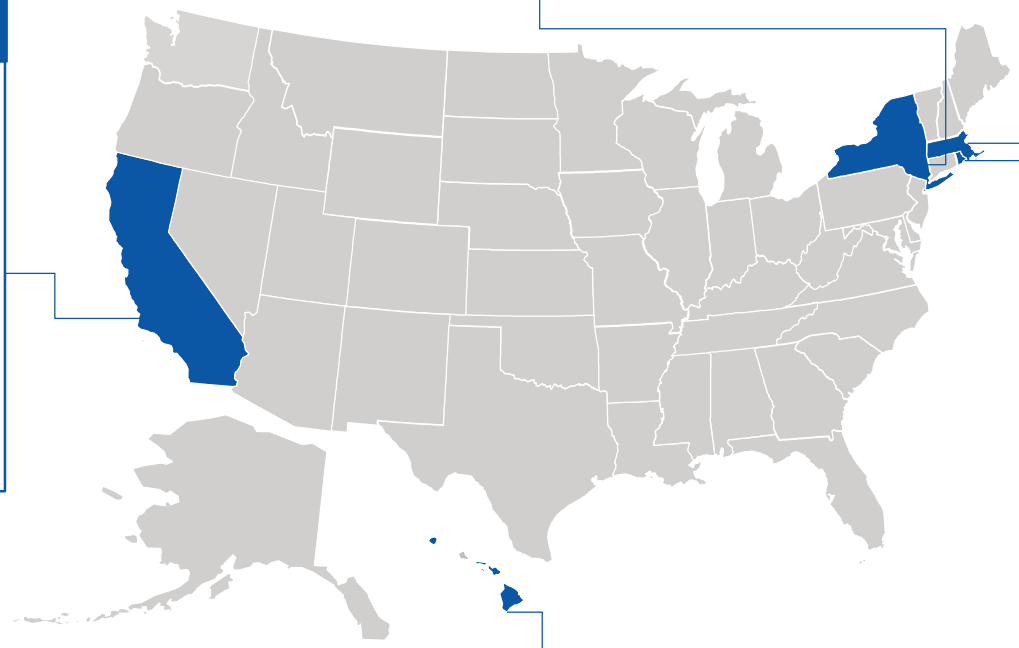
Behind-the-Meter Policy and Market Developments, Q3 2018

New York

NYSERDA published the New York Energy Storage Roadmap outlining ratepayer benefits from storage deployments and recommended an infusion of funds to support storage deployments. **New York's Green Bank** put out an RFI on energy storage financing.

California

Results of the **second DRAM 2019 auction** were announced, which included at least 2 MW of behind-the-meter storage. **SCE** issued a local capacity requirements RFP for the Goleta and Santa Clara regions of the Moorpark sub-area, which could be fulfilled by storage. **CPUC** approved **SCE's PRP 2 contracts;** it also issued a decision allowing cost recovery of both a previously authorized distribution capital project and a distributed energy resources project that defers or replaces the distribution capital project. In addition, it issued a final decision on **SCE's Non-Residential TOU Rate Periods**, with the final rates themselves expected to be finalized in early 2019.



Massachusetts

National Grid added batteries to the list of eligible technologies under its ConnectedSolutions program. A proposal was issued regarding capacity rights' ownership under **DPU 17-146.** S. 2545 from the **state legislature** was signed into law, which would, among other storage-friendly policies, expand the state's mandate to 1 GWh.

Rhode Island

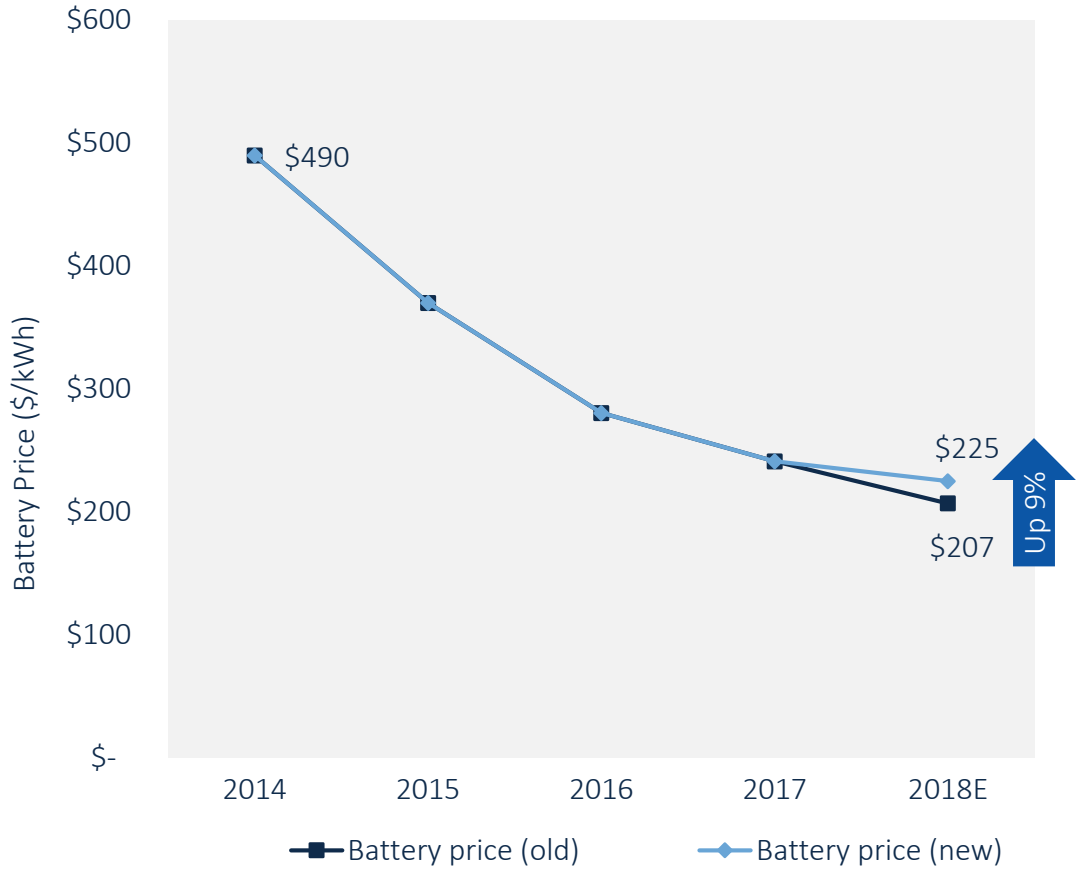
National Grid added batteries to the list of eligible technologies under its ConnectedSolutions program. Two pilot projects are planned under a rate case settlement.

Hawaii

Hawaii PUC issued an order allowing existing solar systems under NEM to add storage so long as the existing NEM export limit is not exceeded.

Lithium-Ion Battery Price Declines Have Slowed Down in 2018

Lithium-Ion Battery Prices, 2014-2018E ($/kWh)



Source: GTM Research

- Lithium-ion battery rack prices declined by more than 20% YOY in 2015 and 2016, and in 2017 prices came down by almost 15%. Growing demand from the EV industry and stationary energy storage market, as well as improvements in energy density, drove the bulk of these historical price declines.
- GTM Research forecasted battery prices to decline by another 14% over the course of 2018, but the pace of price declines has slowed significantly over the last quarter.
- This setback in the pace of price declines is not simply driven by increasing raw materials pricing; instead, it comes from battery cell shortages in the market, especially in the case of nickel-manganese cobalt oxide batteries (NMC) that are being used in both EVs and stationary energy storage. The demand for these NMC batteries is outstripping supply, as there aren't enough cell manufacturing plants operational today to meet the growing demand. However, as greater production capacity comes online over the next two years, the prices are expected to decline further.
- The story for lithium-iron phosphate batteries (LFP) is different. LFP battery capacity is mostly housed in China. As the energy density of LFP batteries isn't as high as that of NMC batteries, they have mostly been used in e-buses/e-trucks, some BTM applications and some FTM power applications. However, as the manufacturing capacity for LFP grows, prices of these batteries will continue to decline, and lead times for NMC battery availability will likely extend to more than six to nine months. As these variables converge, there will be increased interest in LFP batteries for use in energy applications for FTM storage projects.

New York in Focus: Spotlight on a Market That Is Shaping Up to Be More Than Hype

The past 12 months have been good for energy storage in New York, a market that has long been seen as a potential breakout area for the industry and is now making good on that promise. There are initiatives underway at the ISO, utility and legislature levels, backed up by millions of dollars in pledged investments.

New York's current efforts are focused on easing constraints for storage deployments while incentivizing systems to test the waters and determine where value can most readily be captures. Initiatives now underway include:

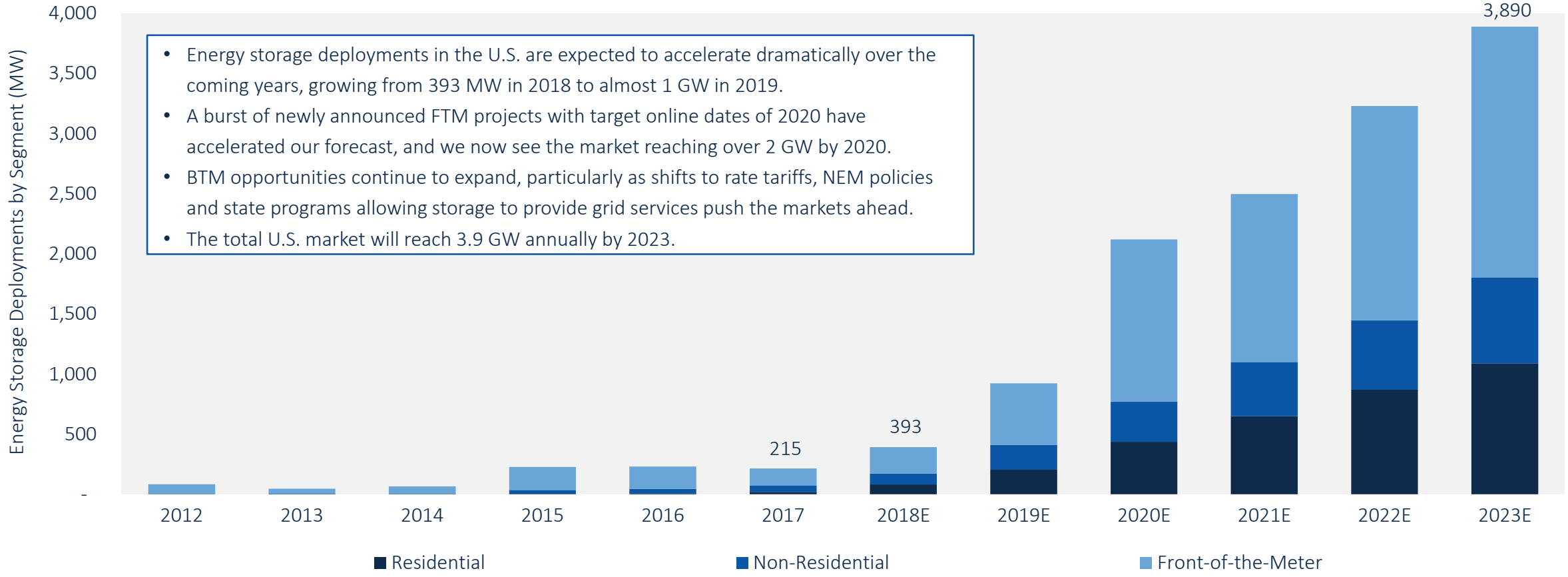
- Ensuring eligibility and providing clarity on participation and regulation:
  - NYISO's ongoing market reform efforts are dovetailing with FERC Order 841, which will enable wholesale market clarity for storage operators.
  - Permitting and safety codes for lithium-ion systems could kick-start a massive potential market in New York City, though additional clarity for outdoor systems is needed.
  - New York City is the only U.S. city with its own storage target: 100 MWh by 2020.
- Identifying and quantifying value from the customer up to the transmission level through Reforming the Energy Vision proceedings, NYISO action and utility pilots.
- Incentivizing deployments through direct investment in storage installations and programs.

GTM Research expects New York to emerge onto the stage in a big way over the next three years, following up on its targets and proposals with batteries on the ground. One of the key reasons for this optimism is New York's status as a single-state market. Single-state markets have a huge advantage – just as in California, New York's ISO, public utility commission, utilities, legislature and governor are all in agreement about the need to incorporate energy storage. While approaches may vary, the fact that the ISO does not have to juggle the needs and priorities of multiple states, as is the case in ISO-NE, MISO, SPP and PJM territories, will allow visions to converge quickly, and we are already seeing this dovetailing occurring in NYSERDA's roadmap and NYISO's proposed market reforms.

Watch this space – stakeholder initiatives and comments are introduced every week, and further rulemakings, targets and reforms are anticipated before the end of 2018. New York is primed to emerge as potentially the second most important market for storage, ranking behind only California, but there are many loose threads yet to tie together, and Arizona and Massachusetts are both making strong cases as economics and regulations drive new states to the forefront. A deeper dive into the New York market is included in the full report.

U.S. Energy Storage Annual Deployments Will Reach 3.9 GW by 2023

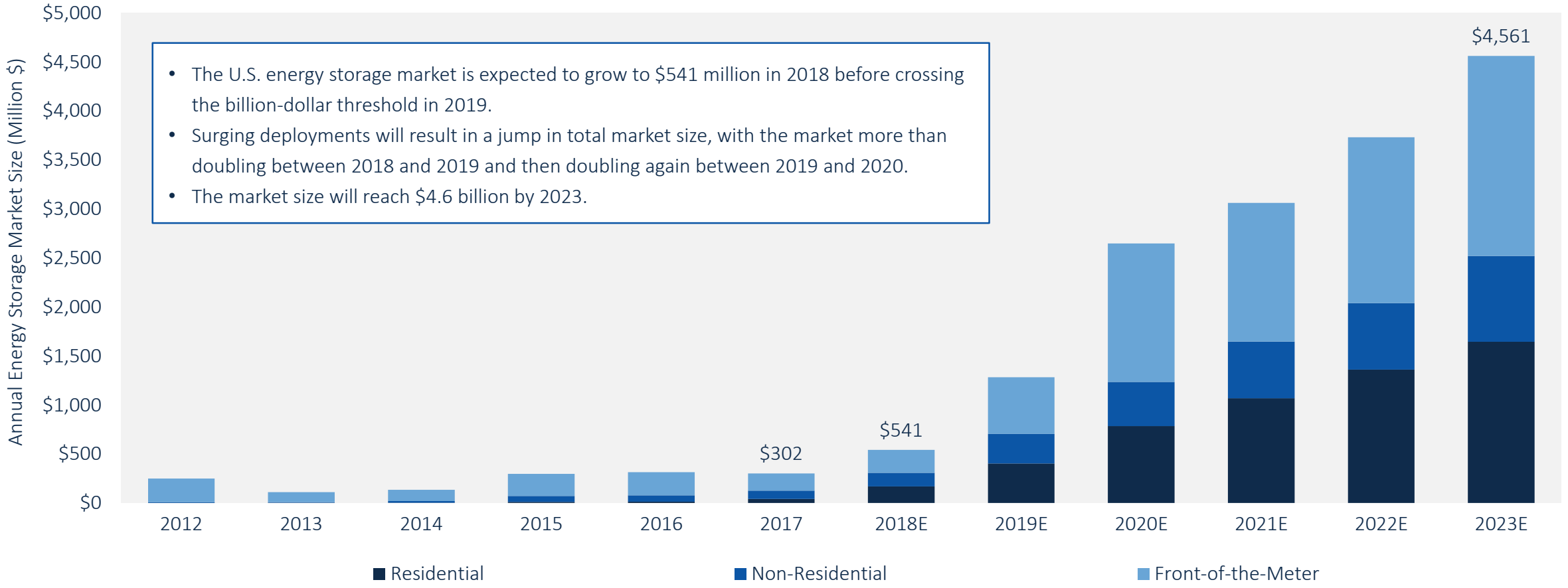
U.S. Annual Energy Storage Deployment Forecast, 2012-2023E (MW)



Source: GTM Research

Energy Storage Will Be a $4.6 Billion Market by 2023

U.S. Annual Energy Storage Market Size, 2012-2023E (Million $)



Source: GTM Research. Market Size is reported as energy storage system deployment revenues (product of deployments and installed system prices).

U.S. Energy Storage Monitor

Produced in a collaboration between Wood Mackenzie Power & Renewables and the Energy Storage Association (ESA), the *U.S. Energy Storage Monitor* is the industry's only comprehensive quarterly research report on energy storage markets, deployments, policies, financing and regulations in the U.S. The report is available for purchase quarterly or as an annual subscription.

Executive Summary vs. Full Report Content

Content	Executive Summary	Full Report
Energy Storage Deployments	National Aggregate	By State and Market Segment
Technology Coverage	Deployments by Technology	Status by Technology
Market Trends	National Highlights	Detailed Analysis
Pricing Data	Not Available	Quarterly Index
Deployment Forecast	National Aggregate	By State and Segment

Report Pricing

Member Status	Executive Summary	Full Report (PDF Enterprise License)	
		Individual Quarterly Report	Annual Subscription (4 Reports)
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Non-ESA Members		$4,000	$10,000

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